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(54) **CATALYTIC FUEL IGNITER**

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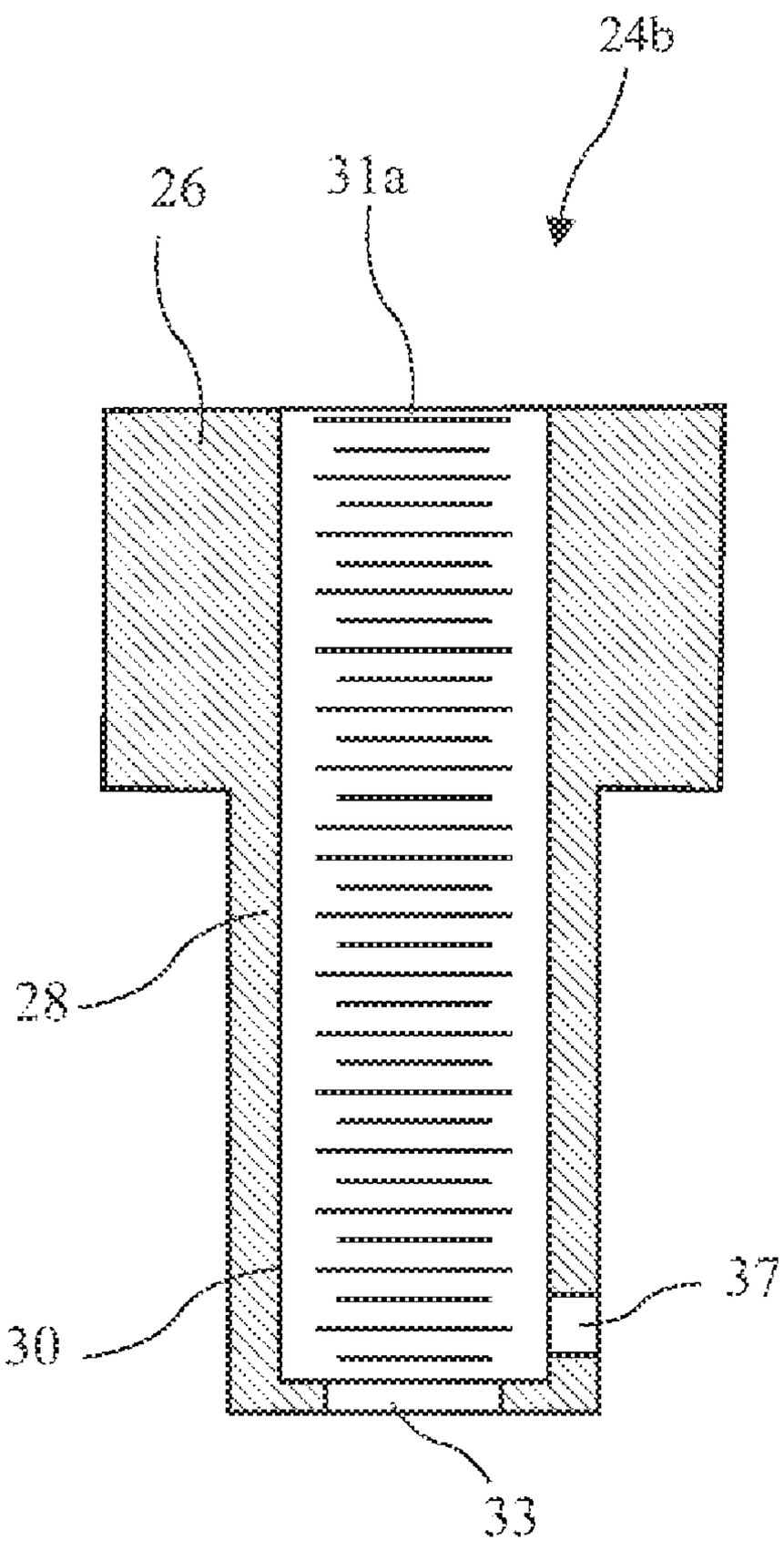
(52) **U.S. Cl.**

CPC ***F02P 23/02*** (2013.01); ***F23Q 11/04*** (2013.01)

(57) **ABSTRACT**

A catalytic fuel igniter is compatible with internal combustion engines and other chemical fuel operated systems. The catalytic fuel igniter does not require electrical components typically required for such systems, thus reducing complexity. The catalytic fuel igniter includes a catalyst in a controlled environment which ignites the fuel and air at the proper time for engine operation. In one embodiment the fuel is a hydrogen fuel and the catalytic fuel igniter is a hydrogen fuel igniter.



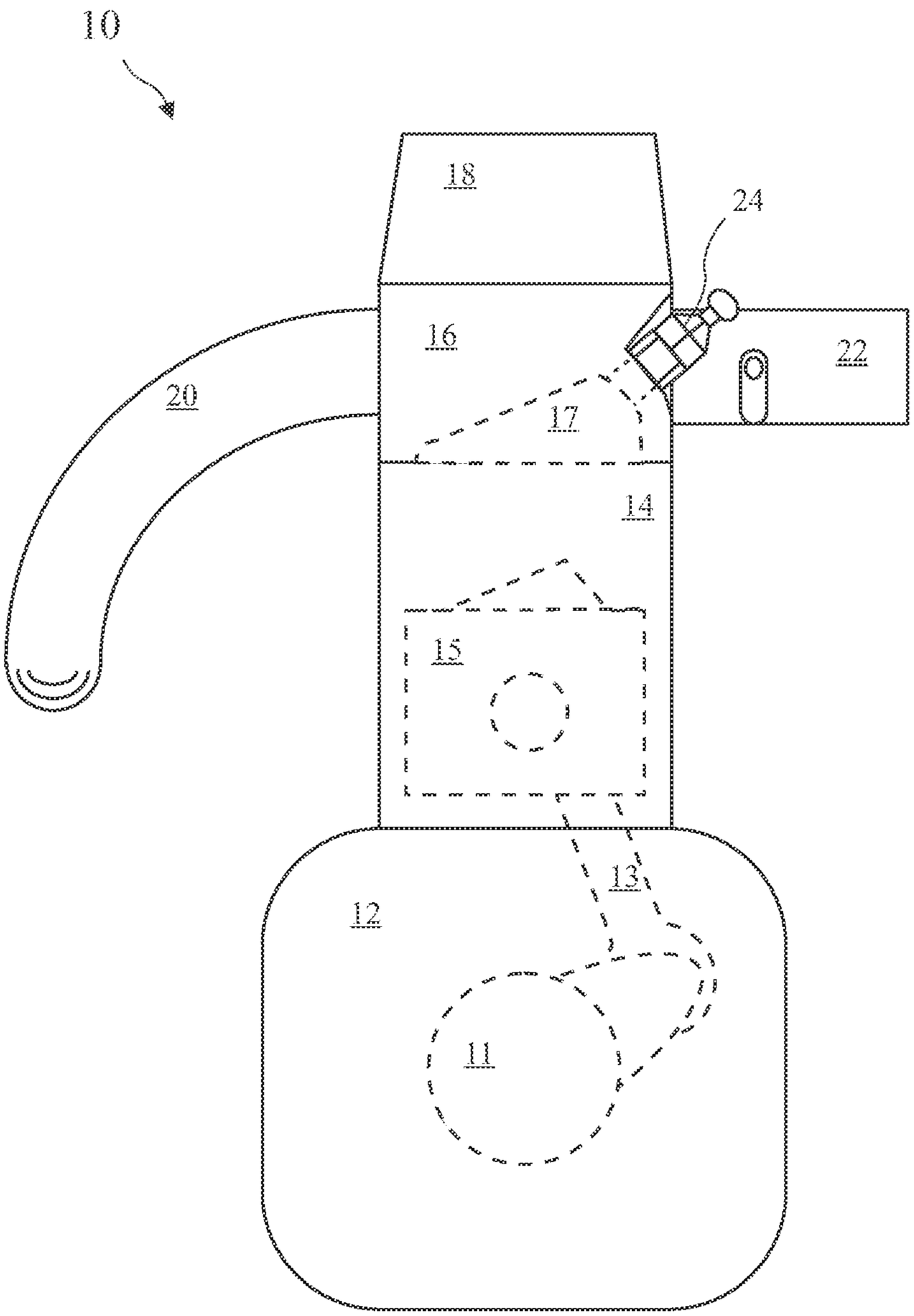


FIG. 1

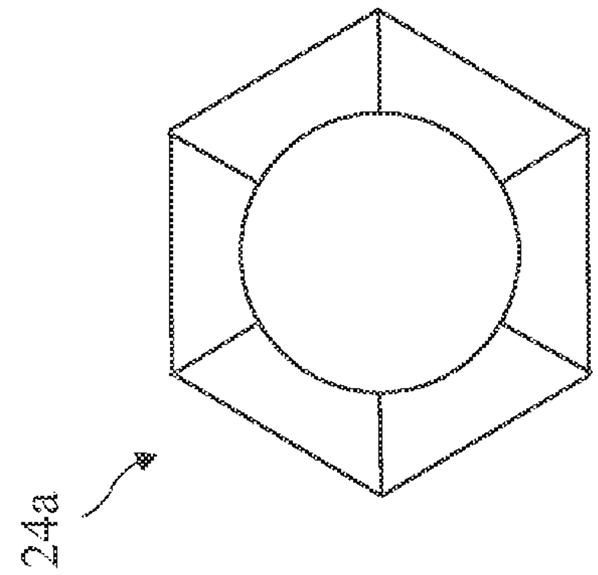


FIG. 2C

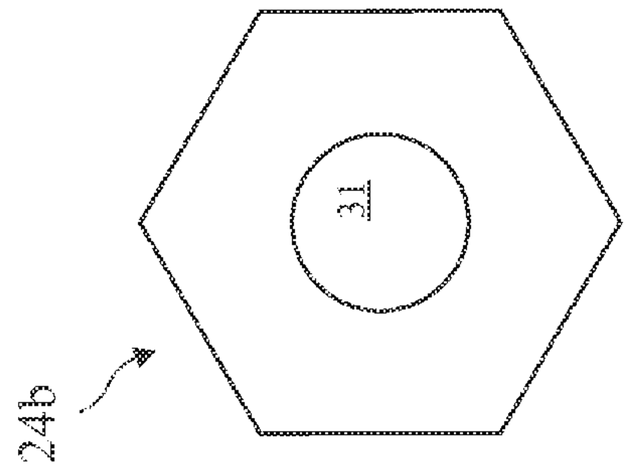


FIG. 3C

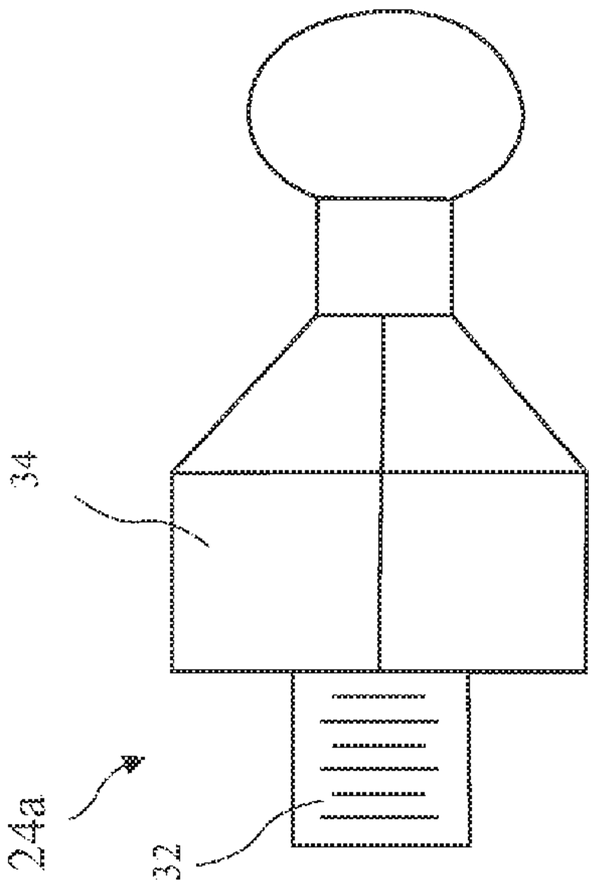


FIG. 2A

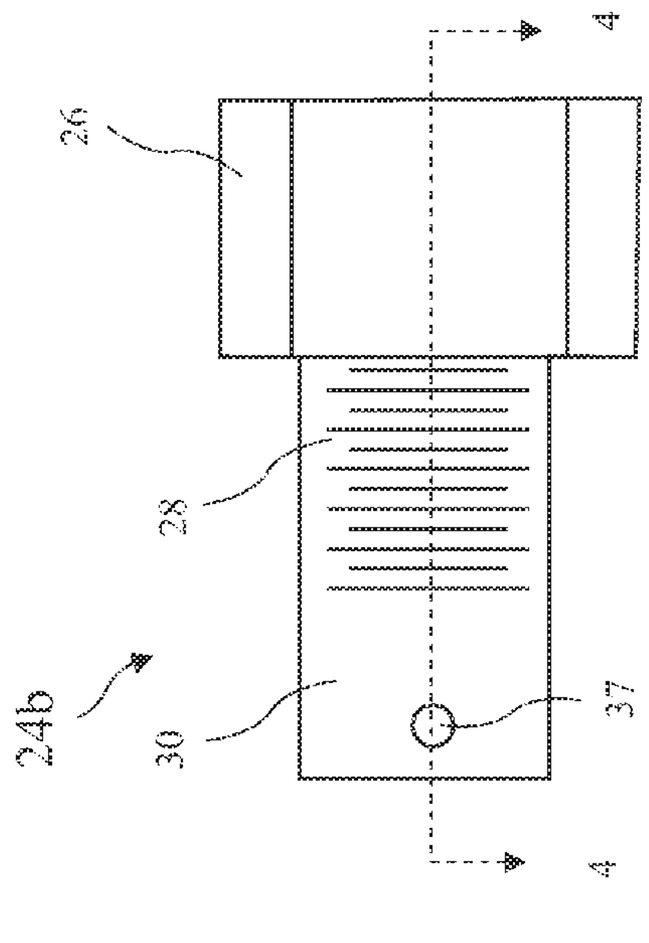


FIG. 3A

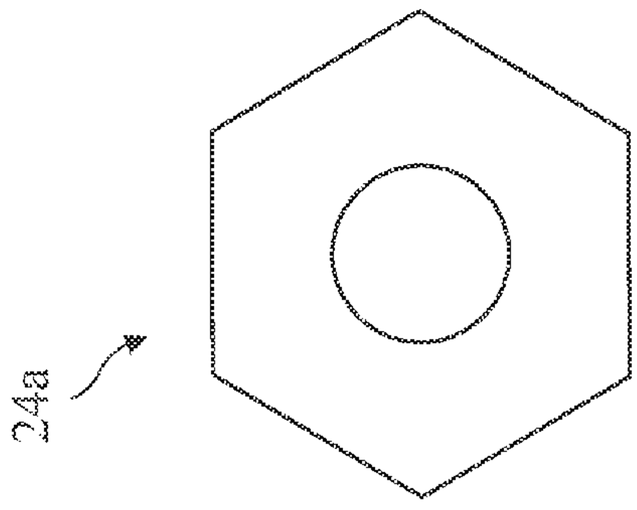


FIG. 2B

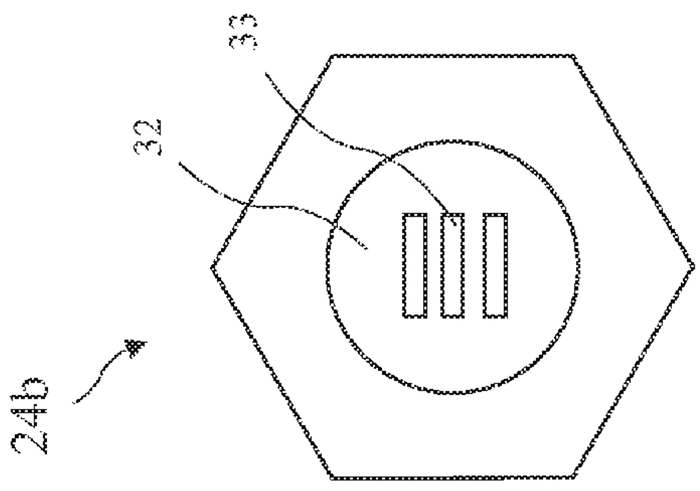


FIG. 3B

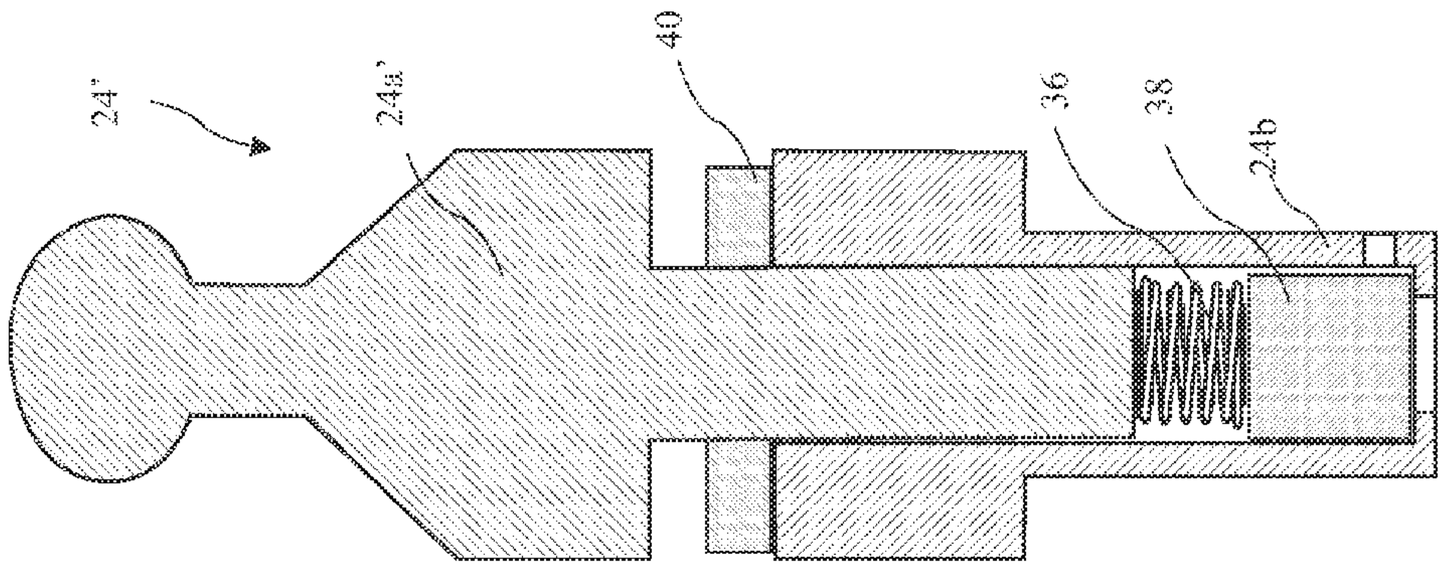


FIG. 7

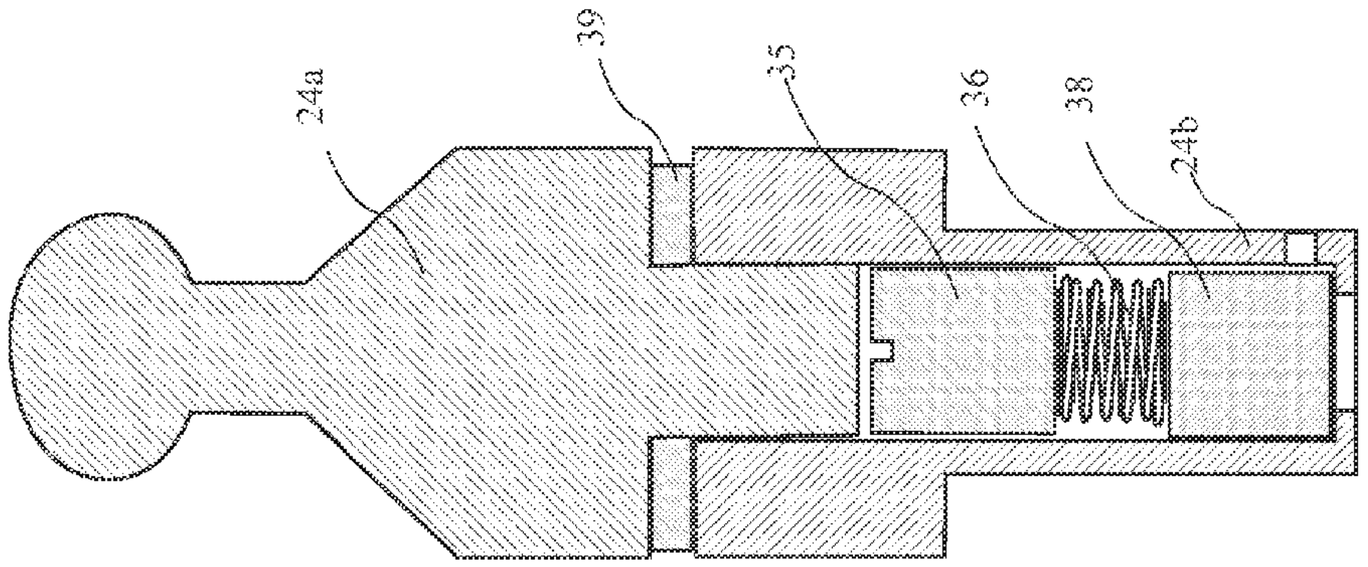


FIG. 5B

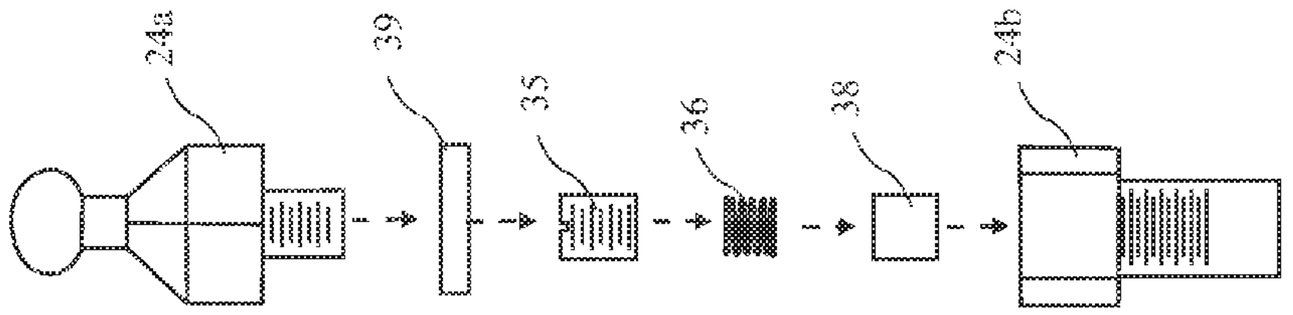


FIG. 5A

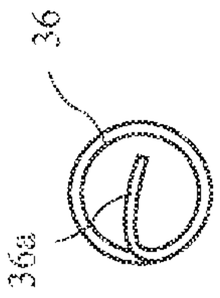


FIG. 6

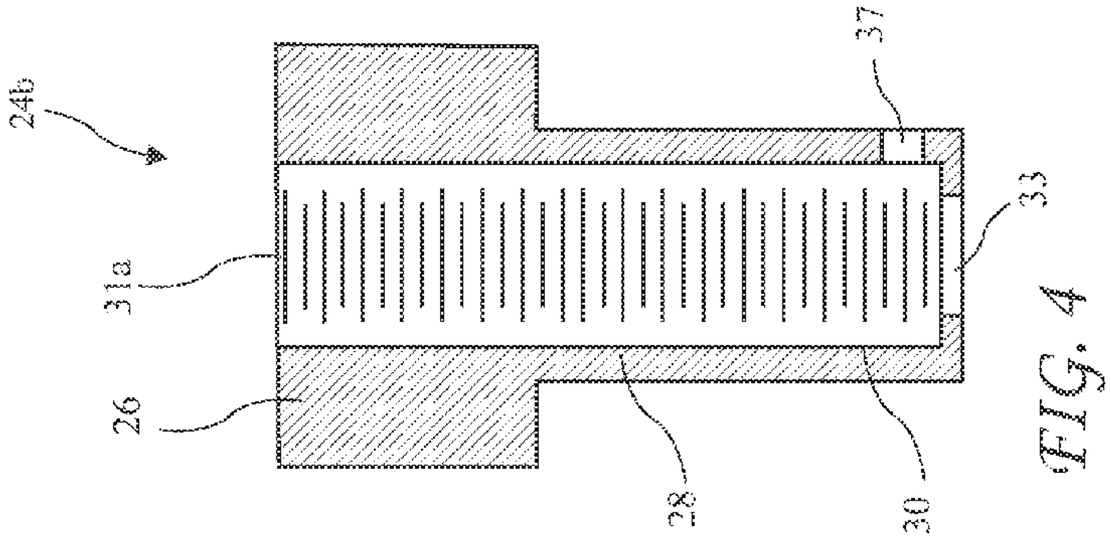


FIG. 4

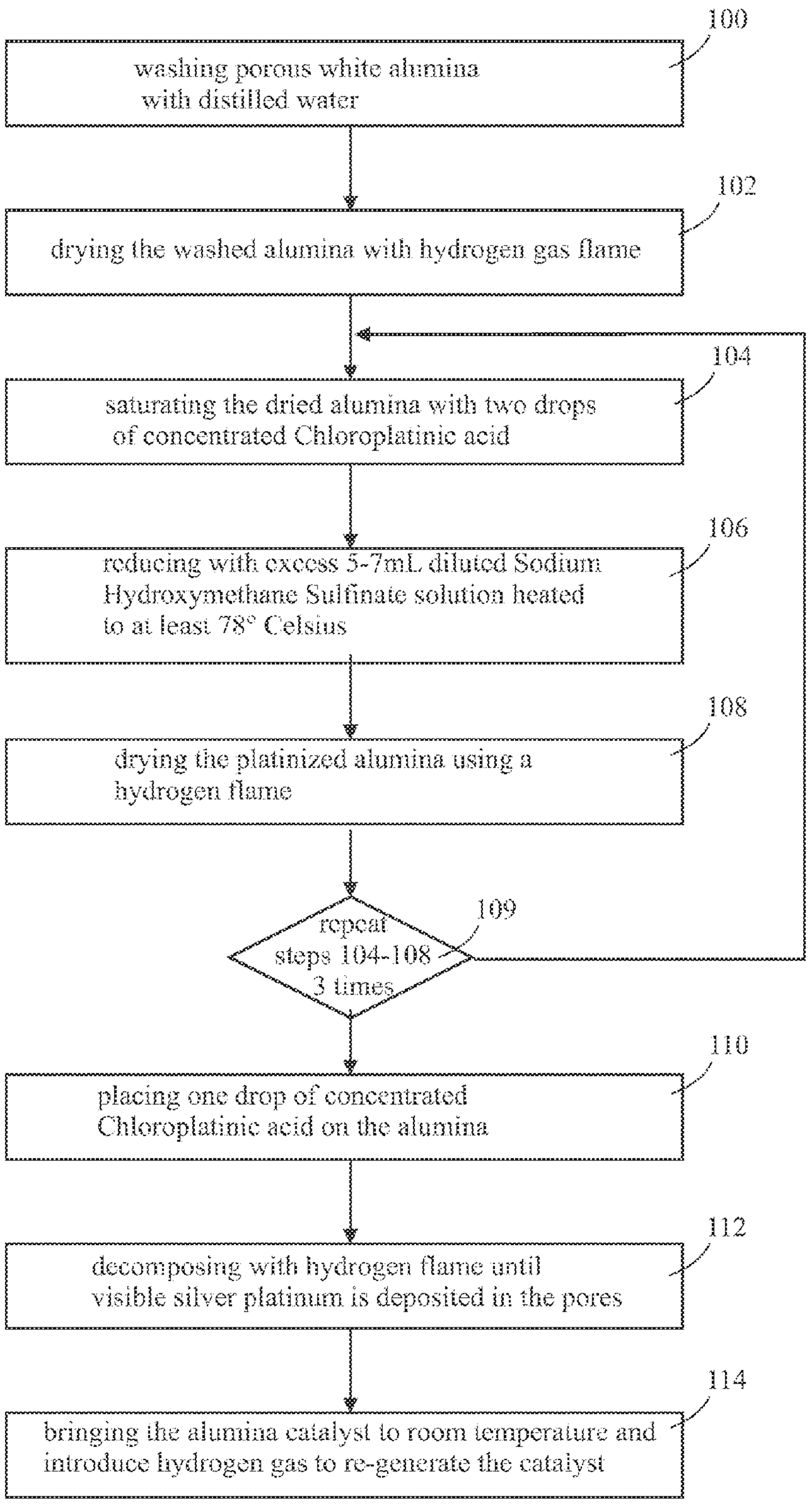

100
washing porous white alumina with distilled water
102
drying the washed alumina with hydrogen gas flame
104
saturating the dried alumina with two drops of concentrated Chloroplatinic acid
106
reducing with excess 5-7mL diluted Sodium Hydroxymethane Sulfinate solution heated to at least 78° Celsius
108
drying the platinized alumina using a hydrogen flame
109
repeat steps 104-108 3 times
110
placing one drop of concentrated Chloroplatinic acid on the alumina
112
decomposing with hydrogen flame until visible silver platinum is deposited in the pores
114
bringing the alumina catalyst to room temperature and introduce hydrogen gas to re-generate the catalyst

FIG. 8

CATALYTIC FUEL IGNITER

[0001] The present application claims the priority of U.S. Provisional Patent Application Ser. No. 61/738,051 filed Dec. 17, 2012, which application is incorporated in its entirety herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to the ignition of internal combustion engines and in particular to a catalytic ignition device for hydrogen fuel internal combustion engines.

[0003] Fossil fuels pose environmental and health challenges. Also, environmental regulations which require companies to develop complex and expensive emission controls have not been effective in completely eliminating the build-up of carbon dioxide and nitrogen oxide compounds in the atmosphere.

[0004] Conventional combustion technologies require carbon based fuel and an oxidizer to be ignited by a spark plug or heating element (e.g., glow plug) utilizing a magnetic/electrical coil or electrical feed. Generally ignition systems are required to provide an electrical signal, and these ignition systems often fail.

[0005] As an alternative to complex fossil fuels, hydrogen is gaining popularity in the world. Hydrogen is safe to use and abundant in nature. In a gaseous form, hydrogen chemically reacts with air to form water as the main product of an exothermic (energy releasing) reaction. The combustion of hydrogen and air delivers approximately 1.5 times more BTU than carbon fuel (e.g., gasoline). However, some form of efficient ignition is still required for hydrogen fueled internal combustion engines.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention addresses the above and other needs by providing a catalytic fuel igniter which is compatible with internal combustion engines and other chemical fuel operated systems. The catalytic fuel igniter does not require electrical components typically required for such systems, thus reducing complexity. The catalytic fuel igniter includes a catalyst in a controlled environment which ignites the fuel and air at the proper time for engine operation. In one embodiment the fuel is a hydrogen fuel and the catalytic fuel igniter is a hydrogen fuel igniter.

[0007] In accordance with one aspect of the invention, there is provided a catalytic fuel igniter which eliminates the need for an electrical ignition system for hydrogen fuel. The catalytic fuel igniter reduces the cost of materials used and increases the efficiency of the hydrogen combustion reaction thereby increasing the efficiency of the engine.

[0008] In accordance with another of the invention, there is provided a catalytic fuel igniter including female fitting including a threaded passage therethrough, a male fitting having a male threaded portion cooperating with the threaded passage of the female fitting attachment of the male fitting of the top of the female fitting, a closed end of the threaded passage opposite the male fitting, the closed end including slits and sides containing orifices, a catalytic plug residing in the threaded passage at the closed end, a spring residing in the threaded passage above the catalytic plug, and a set screw residing in the threaded passage above the spring and threadedly cooperating with the threaded passage to advance and retreat the within the threaded passage by turning the set screw.

[0009] In accordance with still another of the invention, there is provided a catalytic plug made using a method including washing porous white alumina with distilled water, drying the washed alumina with hydrogen gas flame, saturating the dried alumina with two drops of concentrated Chloroplatinic acid, reducing with excess 5-7 mL diluted Sodium Hydroxymethane Sulfinate solution heated to at least 78° Celsius to make platinized alumina, drying the platinized alumina using a hydrogen flame, placing one drop of concentrated Chloroplatinic acid on the platinized alumina, decomposing with hydrogen flame until visible silver platinum is deposited in the pores, and bringing the alumina catalyst to room temperature and introduce hydrogen gas to re-generate the catalyst.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0010] The above and other aspects, features and advantages of the present invention will be more apparent from the following more particular description thereof, presented in conjunction with the following drawings wherein:

[0011] FIG. **1** is an internal combustion engine having a catalytic fuel igniter according to the present invention.

[0012] FIG. **2**A is a side view of a male fitting of the catalytic fuel igniter according to the present invention.

[0013] FIG. **2**B is a bottom view of the male fitting of the catalytic fuel igniter according to the present invention.

[0014] FIG. **2**C is a top view of the male fitting of the catalytic fuel igniter according to the present invention.

[0015] FIG. **3**A is a side view of a female fitting of the catalytic fuel igniter according to the present invention.

[0016] FIG. **3**B is a bottom view of the female fitting of the catalytic fuel igniter according to the present invention.

[0017] FIG. **3**C is a top view of the female fitting of the catalytic fuel igniter according to the present invention.

[0018] FIG. **4** is a cross-sectional view of the female fitting according to the present invention, taken along line **4-4** of FIG. **3**A.

[0019] FIG. **5**A is an exploded view of the catalytic fuel igniter according to the present invention.

[0020] FIG. **5**B is a cross-sectional view of the assembled catalytic fuel igniter according to the present invention.

[0021] FIG. **6** is a bottom view of a spring element of the catalytic fuel igniter according to the present invention.

[0022] FIG. **7** is another embodiment of a catalytic fuel igniter according to the present invention.

[0023] FIG. **8** is a process for making a catalyst plug according to the present invention.

[0024] Corresponding reference characters indicate corresponding components throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0025] The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing one or more preferred embodiments of the invention. The scope of the invention should be determined with reference to the claims.

[0026] A catalytic ignition engine **10** having a catalytic fuel igniter **24** according to the present invention is shown in FIG. **1**. The engine **10** includes an engine block **12**, a cylinder **14**, a head **16**, a valve cover **18**, exhaust **20**, and an air intake **22**.

The engine **10** includes internal components including a crank shaft **11** residing in the engine block **12**, a connecting rod **13** connected to the crank shaft **11**, a piston **15** connected to the connecting rod **13**, and a combustion chamber **17** in the head **16** above the piston **15**. The engine **10** further includes other internal and external parts known to those skilled in the art and not described here. The catalytic fuel igniter **24** may be attached at the location otherwise used by a spark plug or glow plug, or in a location provided specifically for the catalytic fuel igniter **24**.

[0027] A side view of a male fitting **24***a* of the catalytic fuel igniter **24** is shown in FIG. **2**A, a bottom view of the male fitting **24***a* is shown in FIG. **2**B, and a top view of the male fitting **24***a* is shown in FIG. **2**C. The male fitting **24***a* includes a male threaded portion **32** and a wrench attachment portion **34**.

[0028] A side view of a female fitting **24***b* of the catalytic fuel igniter **24** is shown in FIG. **3**A, a bottom view of the female fitting **24***b* is shown in FIG. **3**B, a top view of the female fitting is shown in FIG. **3**C, and a cross-sectional view of the female fitting **24***b* taken along line **4-4** of FIG. **3**A is shown in FIG. **4**. The female fitting **24***b* includes a threaded passage **31** substantially therethrough (i.e., reaching nearly the entire length of the female fitting **24***b*), having an open end **31***a* for threadedly receiving the male fitting **24***a*, and an opposite closed end **32** having slits **33** and passages **37**. The female fitting **24***b* includes male threads **28** for attachment to the engine **10**, an unthreaded portion **30**, and a wrench attachment portion **26** for tightening to the engine **10**. The wrench attachment portions **26** and **34** may be for a common ⅝ inch wrench, and the male threads may be a common spark plug thread of 14.125 mm.

[0029] An exploded view of the catalytic fuel igniter **24** is shown in FIG. **5**A and an assembled view of the catalytic fuel igniter **24** is shown in FIG. **5**B. The catalytic fuel igniter **24** includes the female fitting **24***b* including the threaded passage **31** therethrough, the male fitting **24***a* attachable to the top of the female fitting **24***b*, a catalytic plug **38** residing in the threaded passage **31** at the closed end **32**, a spring residing in the threaded passage **31** above the catalytic plug **38**, a set screw **35** residing in the threaded passage **31** above the spring **36** and threadedly cooperating with the threaded passage **31** to advance and retreat the within the threaded passage **31** by turning the set screw **35**, and a compressible gasket (or seal) **39** captured between the female fitting **24***b* and the male fitting **24***a*. The spring **36** and set screw **35** allow adjustment of force exerted against the catalytic plug **38** to hold the catalytic plug **38** in place and avoid cracks or other damage to the catalytic plug **38**. The compressible gasket **39** fills the gap between the male and female fitting when the male fitting **24***a* is tightened against the set screw **35**. The set screw **35** is a hydrogen compatible material, for example, brass. The male fitting **24***a* tightens against the set screw **35** to prevent loosening the up from heat expansion. The orifices **37** is preferably aligned with the catalytic plug **38** to facilitate saturation of the catalytic plug **38** with hydrogen fuel, and some of the hydrogen fuel generally flows upward past the catalytic plug **38**, thus surrounding the catalytic plug **38**.

[0030] A bottom view of the spring **36** is shown in FIG. **6**. The spring **36** has an inward folded bottom coil **36***a* to rest against the catalytic plug **38**.

[0031] Another embodiment of the catalytic fuel igniter **24'** is shown in FIG. **7**. The catalytic fuel igniter **24'** includes a male fitting **24***a'* and locking nut **40** for fixing the depth of the male fitting **24***a'* in the interior passage **31** of the female fitting **24***b* to apply force to the catalytic plug **38**.

[0032] A process for making a catalyst plug **38** according to the present invention is described in FIG. **8**. The method includes washing porous white alumina with distilled water at step **100**, drying the washed alumina with hydrogen gas flame at step **102**, saturating the dried alumina with two drops of concentrated Chloroplatinic acid at step **104**, reducing with excess 5-7 mL diluted Sodium Hydroxymethane Sulfinate solution heated to at least 78° Celsius to make platinized alumina at step **106**, drying the platinized alumina using a hydrogen flame at step **108**, repeating steps **104**, **106**, and **108** at least 3 times at step **109**, placing one drop of concentrated Chloroplatinic acid on the platinized alumina at step **110**, decomposing with hydrogen flame until visible silver platinum is deposited in the pores at step **112**, and bringing the alumina catalyst to room temperature and introduce hydrogen gas to re-generate the catalyst at step **114**.

[0033] While alumina is a preferred material for making the catalyst plug **38**, alternative materials include other solid material porous which can be platinized. The catalytic fuel igniter **24** may also be used for starting jet engines and as an igniter for rocket engines. An igniter according to the present invention may further be used with methane, butane, and propane fuels with a modified catalyst.

[0034] While other materials may be used, examples of suitable materials for the male fitting and female fitting are 303 stainless, 304 stainless and 314 stainless.

[0035] While the invention herein disclosed has been described by means of specific embodiments and applications thereof, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope of the invention set forth in the claims.

I claim:

1. A catalytic fuel igniter comprising:

a female fitting including an interior passage substantially therethrough;

an open end of the interior passage;

a closed end of the interior passage opposite the open end;

at least one slit through the closed end of the interior passage;

a male fitting engageable with the female fitting to close the open end of the interior passage of the female fitting;

a catalytic plug residing in the interior passage at the closed end and in fluid communication with an exterior of the catalytic fuel igniter through the at least one slit.

2. The catalytic fuel igniter of claim **1**, wherein the catalytic plug is held against the closed end of the interior passage.

3. The catalytic fuel igniter of claim **2**, wherein cooperation of the male fitting with the female fitting holds the catalytic plug against the closed end of the interior passage.

4. The catalytic fuel igniter of claim **3**, wherein a portion of the male fitting resides in the interior passage of the female fitting holding the catalytic plug against the closed end of the interior passage.

5. The catalytic fuel igniter of claim **2**, wherein a set screw resides in the interior passage of the female fitting, the set screw holding the catalytic plug against the closed end of the interior passage.

6. The catalytic fuel igniter of claim **5**, wherein a spring resides between the set screw and the catalytic plug in the interior passage of the female fitting, the spring holding the catalytic plug against the closed end of the interior passage.

7. The catalytic fuel igniter of claim **1**, wherein:
the interior passage of the female fitting includes female threads;
the male fitting includes male threads on a cooperating portion residing in the interior passage of the female fitting, the make and female threads attaching the male fitting to the female fitting

8. The catalytic fuel igniter of claim **1**, further including orifices in walls of the interior passages adjacent to the catalytic plug;

9. The catalytic fuel igniter of claim **1**, wherein the catalytic plug is made using the process:
washing porous white alumina with distilled water;
drying the washed alumina with hydrogen gas flame;
saturating the dried alumina with two drops of concentrated Chloroplatinic acid;
reducing with excess 5-7 mL diluted Sodium Hydroxymethane Sulfinate solution heated to at least 78° Celsius to make platinized alumina;
drying the platinized alumina using a hydrogen flame;
placing one drop of concentrated Chloroplatinic acid on the platinized alumina;
decomposing with hydrogen flame until visible silver platinum is deposited in the pores; and
bringing the alumina catalyst to room temperature and introduce hydrogen gas to re-generate the catalyst.

10. A catalytic ignition engine comprising:
an engine block;
a cylinder portion;
a head;
an exhaust;
an air intake;
a crank shaft residing in the engine block;
a connecting rod connected to the crank shaft;
a piston connected to the connecting rod;
a combustion chamber in the head above the piston. and
a catalytic fuel igniter attached to the head and reaching to the combustion chamber, the catalytic fuel igniter comprising:
a female fitting including an interior passage substantially therethrough;
an open end of the interior passage;
a closed end of the interior passage opposite the open end;
at least one slit through the closed end of the interior passage;
a male fitting engageable with the female fitting to close the open end of the interior passage of the female fitting;
a catalytic plug residing in the interior passage at the closed end and in fluid communication with an exterior of the catalytic fuel igniter through the at least one slit.

11. The catalytic ignition engine of claim **10**, wherein the catalytic plug is made using the process:
washing porous white alumina with distilled water;
drying the washed alumina with hydrogen gas flame;
saturating the dried alumina with two drops of concentrated Chloroplatinic acid;
reducing with excess 5-7 mL diluted Sodium Hydroxymethane Sulfinate solution heated to at least 78° Celsius to make platinized alumina;
drying the platinized alumina using a hydrogen flame;
placing one drop of concentrated Chloroplatinic acid on the platinized alumina;
decomposing with hydrogen flame until visible silver platinum is deposited in the pores; and
bringing the alumina catalyst to room temperature and introduce hydrogen gas to re-generate the catalyst.

12. A catalytic fuel igniter comprising:
a female fitting including an interior passage substantially therethrough;
an open end of the interior passage;
a closed end of the interior passage opposite the open end;
at least one slit through the closed end of the interior passage;
a male fitting engageable with the female fitting to close the open end of the interior passage of the female fitting;
a catalytic plug residing in the interior passage at the closed end and in fluid communication with an exterior of the catalytic fuel igniter through the at least one slit, the catalytic plug is made using a method comprising:
washing porous white alumina with distilled water;
drying the washed alumina with hydrogen gas flame;
saturating the dried alumina with two drops of concentrated Chloroplatinic acid;
reducing with excess 5-7 mL diluted Sodium Hydroxymethane Sulfinate solution heated to at least 78° Celsius to make platinized alumina;
drying the platinized alumina using a hydrogen flame;
placing one drop of concentrated Chloroplatinic acid on the platinized alumina;
decomposing with hydrogen flame until visible silver platinum is deposited in the pores; and
bringing the alumina catalyst to room temperature and introduce hydrogen gas to re-generate the catalyst.

* * * * *